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硕　士　学　位　论　文

图像分析多核并行计算类库的构建与优化

Construction and Optimization on Multi-Core Parallel Computing Class for Image Analysis

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摘 要

多核并行计算技术是当前计算机领域的研究热点。在未来数年内，随着芯片内核数量持续增长，多核计算将成为一种广泛普及的计算模式。它使计算机的计算能力显著提升，具有巨大的发展潜力和广阔的应用空间。当前，CPU 主频的提升由于生产工艺和散热问题而受到严重的制约，CPU 性能的改善已主要向着多核体系发展。然而，要想真正获得多核处理器带来的高效率，软件的发展必须跟上硬件的步伐，当前多核处理器软件总体滞后于硬件。传统的单线程串行计算软件只能导致多核的闲置，只有在算法设计及软件开发能够充分利用多核处理器的特性时，其优势才能真正体现出来。

本文围绕多核并行计算在图像分析领域的应用展开研究，探讨算法设计和类库实现。课题研究的内容包括：

(1)在详细剖析多核体系结构和并行算法的基础上，分析影响多核并行计算性能的主要因素，探讨适合于发挥多核性能的算法和编程技术；

(2)在详细剖析边缘检测、图像分割和图像合成等基本算法的基础上，分析算法中存在的并行性，并根据这种并行性构建支撑图像分析功能的并行计算类库；

(3)分析函数库代码，设计基于多核架构的图像分析并行计算类库，并测试其性能，根据代码在多核架构上的性能表现做出相应的调整；对设计的类库代码从源码级优化、代码并行化和编译器优化等方面进行优化；

(4)优化策略完成之后，根据 Amdahl 定律和 Gustafson 定律做出扩展性分析，得出客观的性能评价。

当前，图像监控技术在军事、环境、地质、气象、治安、交通、工业等领域的应用非常广泛，图像的采集又日益趋向高精度、大幅面和高频度，同时监控系统也逐步由人工判读向智能处理方向发展。由此导致对图像分析高性能计算的迫切需求。本文的研究适应了当前计算机软硬件技术的发展趋势，有助于提高图象分析的实时性和精确度。课题的特色与创新点主要有两点：一是将图像分析函数库由传统的串行运算改造为 IA 上的高性能多核并行计算；二是采用崭新技术进行并行代码的性能分析，实现计算软件的算法结构优化、编译优化和源码级优化，提高其运算效率和适应硬件发展的扩展性。

Intel 架构上的多核 CPU 是近两年刚面世的崭新技术，适应于这一体系的应用软件技术的研究刚刚开始，相关资料和可以借鉴的应用成果较少。本文对此进行了初步探讨，许多研究专题还有待进一步拓展和深化。

关键词：多核并行；图像分析；性能优化

Abstract

Multi-core parallel computing technology is the current hot researching field of computer science. In the near future, along with sustained growth of the number of core in a chip, multi-core computation will become a widely popular computing model, and significantly improve the calculation ability of computers, with great development potential and broad application of space. Presently, the CPU basic frequency's promotion receives the serious restriction as a result of the technique of production and the radiation question, the CPU performance improvement has mainly turned toward the multi-core system development. However, if wants to obtain the high efficiency which truly the multi-core processor brings, software's development must follow hardware's step, current multi-core processor software overall lag in hardware. The traditional single thread serial computation software can only cause the multi-core processor idle, when the algorithm design and the software development can use the multi-core processor's characteristic fully, its superiority can manifest truly.

This article launches the research regarding the multi-core parallel computing in the image analysis domain's application, the discussion algorithm design and parallel class realizes. The topic research's content includes:

(1)In the foundation of analyzing parallel computation and multi-core architecture, analyze the main factors, which influence parallel on multi-core, and performance bottleneck, probe into the latest programming technology, which are suitable for multi-core;

(2)In the foundation of introducing edge detection, image segmentation and image matching, analyze the parallelism of the image processing fundamental arithmetic, and according to this kind of parallel construction support image analysis function's parallel computing class, and tests its performance;

(3) Analyze the code of function class, design image analysis parallel computing class based-on multi-core architecture and test the performance, according to the code in the framework of multi-core performance, make out corresponding adjustment. Optimize the class code from source code, code parallel and the correctness check;

(4)After optimization, make out the extended analysis according to Amdahl law and Gustafson law，obtain the external performance evaluation.

Presently, the image monitoring technology is used popularly in military, environment, geology, meteorology, public security, transportation and industry applications, image gathering tends to the high accuracy the great width and the high frequency day by day,, simultaneously the supervisory system also gradually develops by the artificial interpret to the intelligent processing direction. So the image analysis high performance computation urgently demands. This article research adapts to the current computer software and hardware technology trend of development, is helpful in enhancing the image analysis real-time and the precision. The topic characteristic and innovation mainly have two points: First, the image analysis function class by the traditional serial arithmetic transformation is on the IA high performance multi-core parallel computing; Second, uses the brand-new technology to carry on the parallel code the performance analysis, realizes calculates software's algorithm structure to optimization, the complier optimization and the source code level optimizes, enhances the extension which its operation efficiency and the adaptation to hardware develop.

On Intel construction multi-core CPU is the brand-new technology which in the recent two years just appeared on the market. The research adapted to this system's application software technology is just started, the correlation data and the application achievement might use for reference were few.

The research based on multi-core structure is quite scarce currently. This thesis carries on a preliminary exploration to image analysis parallel computation class. Many topics need to be expanded for further research.

Key Words：Multi-Core Parallel；Image Analysis；Performance Optimization

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